DOE has identified no subsection of the population that would be disproportionately affected by transportation related to the Proposed Action, DOE has concluded that no disproportionately high and adverse impacts would be likely on minority or low-income populations from the national transportation of spent nuclear fuel and high-level radioactive waste to Yucca Mountain.

Section 6.3.4 discusses environmental justice in relation to transportation in Nevada. Chapter 4, Section 4.1.13.4, contains a discussion of a Native American perspective on the Proposed Action.

6.3 Nevada Transportation

The analysis of impacts from national transportation includes those from transportation activities in the State of Nevada. This section discusses Nevada transportation impacts separately to ensure that the impacts of alternative transportation modes in Nevada are apparent. Spent nuclear fuel and high-level radioactive waste shipped to the repository by legal-weight truck would continue in the same vehicles to the Yucca Mountain site. Material that traveled by rail would either continue to the repository on a newly constructed branch rail line or transfer to heavy-haul trucks at an intermodal transfer station that DOE would build in Nevada for shipment on existing highways that could require upgrades. Selection of a specific rail alignment within a corridor, or the specific location of an intermodal transfer station or the need to upgrade the associated heavy-haul truck routes, would require additional field surveys, environmental and engineering analysis, state, local, and Native American Tribal government consultation, and National Environmental Policy Act reviews.

The transportation analysis in the EIS treats the candidate legal-weight truck routes, rail corridors, and heavy-haul truck routes as current analysis tools and refers to them in the present tense. The EIS refers to impacts associated with these alternatives in the conditional voice *(would)* because they would not occur unless DOE proceeded with the Proposed Action. This convention is applied whenever the EIS discusses the transportation implementing alternatives.

This section describes potential impacts of three transportation scenarios and their respective implementing alternatives. The three transportation scenarios are (1) mostly legal-weight truck (corresponding to that portion of the national impacts that would occur in Nevada), (2) mostly rail, and (3) mostly heavy-haul truck.

The mostly legal-weight truck scenario does not include implementing alternatives. Under this scenario, highway shipments would be restricted to specific routes that satisfy the regulations of the U.S. Department of Transportation (49 CFR Part 397). Because the State of Nevada has not designated alternative preferred routes, only one combination of routes for legal-weight truck shipments would satisfy U.S. Department of Transportation routing regulations (I-15 to U.S. Highway 95 to Yucca Mountain). This scenario assumes that over 24 years approximately 300 shipments of naval spent nuclear fuel would arrive in Nevada by rail from the Idaho National Engineering and Environmental Laboratory and that heavy-haul trucks would transport them to the repository from a railhead.

The mostly rail scenario has five implementing alternatives, each of which includes a corridor with variations for a branch rail line in Nevada. Each implementing alternative includes the construction and operation of a rail line. These alternatives would include about 1,079 legal-weight truck shipments (about 45 per year) from 6 commercial sites that, while operational, would not have the capability to load rail casks.

The mostly heavy-haul truck scenario has implementing alternatives for five different routes on existing Nevada highways. The highways would have to be upgraded to enable heavy-haul trucks routinely to transport rail casks containing spent nuclear fuel and high-level radioactive waste from an intermodal transfer station to the repository. Each heavy-haul truck implementing alternative includes the

construction and operation of an intermodal transfer station that DOE would use to transfer loaded rail casks from railcars to heavy-haul trucks and empty rail casks from the trucks to railcars. The analysis considered three potential intermodal transfer station locations. Each heavy-haul implementing alternative would also include 1,079 legal-weight truck shipments over 24 years from the 6 commercial sites that, while operational, would not have the capability to load rail casks.

Chapter 2, Section 2.1.3.3, contains detailed descriptions of the transportation scenarios and implementing alternatives in Nevada. Sections 6.3.1 through 6.3.3 discuss potential impacts for the three Nevada transportation scenarios. Section 6.3.1 discusses potential environmental impacts that could occur in Nevada for the national mostly legal-weight truck scenario. Section 6.3.2 discusses potential environmental impacts for each of the five Nevada rail transportation implementing alternatives, including those from the construction and operation of a branch rail line, and the impacts of 1,079 legal-weight truck shipments over 24 years. Section 6.3.3 discusses potential impacts of each of the five Nevada heavy-haul truck transportation implementing alternatives, including upgrading Nevada highways, the associated activities of constructing and operating an intermodal transfer station, and the impacts of 1,079 legal-weight truck shipments over the 24 years of operations. Appendix J, Section J.3.6, presents an analysis of impacts of transporting people and materials that would be necessary to implement the Proposed Action. Appendix J also discusses the methods used to analyze impacts for the 12 resource areas.

The EIS analysis evaluated potential impacts that would occur in Nevada from the construction and operation of a branch rail line or from upgrades to highways and construction and operation of an intermodal transfer station for the following environmental resource areas: land use and ownership; air quality; hydrology (surface water and groundwater); biological resources and soils; cultural resources; occupational and public health and safety; socioeconomics; noise and vibration; aesthetics; utilities, energy, and materials; waste management; and environmental justice. The following paragraphs describe the methods used to evaluate potential impacts to these resource areas for each of the three Nevada transportation scenarios—legal-weight truck, rail, and heavy-haul truck—and their applicable implementing alternatives.

Tables 6-16 and 6-17 compare the impacts of the Nevada rail and heavy-haul implementing alternatives, respectively, along with the impacts in Nevada under the mostly legal-weight truck scenario. The comparisons in the tables show that potential health and safety impacts to the public and workers in Nevada would be small for both the mostly legal-weight truck and mostly rail transportation scenarios. In addition, the tables illustrate that impacts would be similar among the 10 rail and heavy-haul truck implementing alternatives. The radiological impacts of incident-free transportation in the State for any of the 10 implementing alternatives or for the mostly legal-weight truck scenario would be small for both the public and workers. The radiological impact from 24 years of transportation would range from 0.0009 to 0.17 latent cancer fatality in the population along routes. The radiological impact to transportation workers from 24 years of operations would range from 0.28 to 0.75 latent cancer fatality for the mostly rail scenario with a Valley Modified Corridor branch rail line and the mostly legal-weight truck scenario, respectively.

As many as 5 latent cancer fatalities could occur from a maximum reasonably foreseeable accident involving a rail shipment. Less than 1 (0.5) latent cancer fatality would occur as the result of a severe truck accident with a similar probability. These accidents would have a chance of occurring nationally of less than 3 in 10 million per year. Because only a small part of each national route is in Nevada, the rate of occurrence in the State would be much less than that nationally. Accidents that would be more likely would have lesser consequences.

Traffic fatalities in Nevada and fatalities caused by the effects of vehicle emissions would be greater for the mostly rail transportation scenario than for the mostly legal-weight truck scenario. The estimate of

Table 6-16. Comparison of impacts for Nevada rail implementing alternatives and for legal-weight truck shipments (page 1 of 2).

Impact	Mostly rail with branch rail					Mostly legal-weight truck
	Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified	
Corridor length (kilometers)	512 - 553	514 - 544	344 - 382	181 - 204	159 - 163	230 - 270
Land use and ownership						
Disturbed land (square kilometers)[a]	18 - 20	19 - 20	13 - 14	9.2 - 10	5 - 5.2	0
Private land (square kilometers)	0.9 - 2.5	7.3 - 15	0.8 - 1.1	0.1 - 3.5	0 - 0.18	0
Nellis Air Force Range land (square kilometers)	0 - 11	0 - 11	22	0	3.6 - 7.5	0
Tribal	0 - 1.6	0 - 1.6	0	0	0	0
Air quality						
PM_{10} and carbon monoxide (construction and operations)	Areas in attainment of air quality standards - branch rail line not a significant source of pollution	Areas in attainment of air quality standards - branch rail line not a significant source of pollution	Areas in attainment of air quality standards - branch rail line not a significant source of pollution	Except in Clark County, areas in attainment of air quality standards - branch rail line not a significant source of pollution	Clark County is in nonattainment of air quality standards for PM_{10} - branch rail line construction could be a significant source of pollution[b]	Not a significant source of pollution
Hydrology						
Surface water	Low	Low	Low	Low	Low	None
Surface water resources along route	5	6	3	0	0	NA[d]
Flood zones	9	11	At least 3	7	2	NA
Groundwater						
Water use (acre-feet)[c]	710	660	480	410	320	0
Water use (number of wells)	64	67	43	23	20	0
Biological resources and soils	Low	Low	Low	Low	Low	Very low
Cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological or historical resources. Route passes close to the Las Vegas Paiute Indian Reservation	Since shipments would use existing highways, none to archaeological or historical resources. Shipments from the northeast would pass through the Moapa Indian Reservation. All shipments would pass through the Las Vegas Paiute Indian Reservation
Noise	Moderate	Low	Moderate	Moderate	Moderate	Low
Utilities and resources						
Diesel (million liters)[e]	45	41	36	30	14	Very low
Gasoline (thousand liters)	940	840	680	570	280	
Steel (thousand metric tons)[f]	78	75	52	29	23	0
Concrete (thousand metric tons)[g]	460	420	310	170	130	0

Table 6-16. Comparison of impacts for Nevada rail implementing alternatives and for legal-weight truck shipments (page 2 of 2).

Impact	Mostly rail with branch rail					Mostly legal-weight truck
	Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified	
Aesthetics	Very low	Very low	Very low	Potential small area of conflict	Very low	None
Socioeconomics						
New jobs (percent of workforce in affected counties	840 (< 1% - 3.2%)	780 (< 1%)	650 (<1% - 2.3%)	530 (< 1%)	250 (< 1%)	Very low
Peak real disposable income (million dollars)	24	21	19	15	7	Very low
Peak incremental Gross Regional Product (million dollars)	40	36	31	26	13	Very low
Waste management	Limited quantity	Limited quantity	Limited quantity	Limited quantity	Limited quantity	Very low
Environmental justice (disproportionately high and adverse impacts)	None	None	None	None	None	None
Incident-free health and safety						
Industrial hazards						
Total recordable incidents	220	200	180	150	110	NA
Lost workday cases	110	100	90	80	60	NA
Fatalities	0.43	0.41	0.38	0.3	0.25	NA
Collective dose (person-rem [LCFs])						
Workers	850 [0.34]	980 [0.39]	740 [0.3]	760 [0.3]	710 [0.28]	1,900 [0.75]
Public	19 [0.009]	38 [0.019]	50 [0.025]	130 [0.06]	23 [0.012]	340 [0.17]
Fatalities from vehicle emissions	0.25	0.25	0.2	0.23	0.13	0.086
Accident impacts, nonradiological traffic						
Construction and operations workforce	1.9	1.8	1.5	1.2	0.9	NA
SNF[h] and HLW[i] shipping	0.07	0.09	0.05	0.06	0.05	0.49
Accident impacts, radiological						
Radiological accident risk						
Person-rem	0.002	0.003	0.002	0.007	0.002	0.053
Latent cancer fatalities	0.0000009	0.0000013	0.0000009	0.0000036	0.000001	0.000026
Maximum reasonably foreseeable accident						
Maximally exposed individual (rem)	29	29	29	29	29	3
Individual latent cancer fatality probability	0.014	0.014	0.014	0.014	0.014	0.0015
Collective dose (person-rem)	9,900	9,900	9,900	9,900	9,900	1,100
Latent cancer fatalities	4.9	4.9	4.9	4.9	4.9	0.55

a. Convert square kilometers to acres, multiply by 247.1.
b. Conformity determination could be required (see Chapter 6, Sections 6.3.2.1 and 6.3.2.2.5).
c. To convert acre-feet to gallons, multiply by 325,850.1.
d. NA = not applicable.
e. To convert liters to gallons, multiply by 0.26418.
f. To convert metric tons to tons, multiply by 1.1023.
g. To convert cubic feet to cubic meters, multiply by 0.028317.
h. SNF = spent nuclear fuel.
i. HLW = high-level radioactive waste.

Table 6-17. Comparison of impacts for Nevada heavy-haul truck implementing alternatives and for legal-weight truck shipments (page 1 of 3).

	Mostly rail with heavy-haul truck					
Impact	Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake	Mostly legal-weight truck
Corridor length (kilometers)	530	280	380	190	180	230 - 270
Land use and ownership						
Disturbed land (square kilometers)[a]	3.4	1.3	2.1	0.63	0.63	0
Private land (square kilometers)	0	0	0	0	0	0
Nellis Air Force Range land (square kilometers)	0	0	0	0	0	0
Air quality						
PM_{10} and carbon monoxide (construction and operations)	Areas in attainment of air quality standards - not a significant source of pollution	Areas in attainment of air quality standards - not a significant source of pollution	Clark County is in nonattainment of air quality standards - heavy-haul route construction could be a significant source of pollution[b]	Except in Clark County, areas in attainment of air quality standards - not a significant source of pollution	Except in Clark County, areas in attainment of air quality standards - not a significant source of pollution	Not a significant source of pollution
Hydrology						
Surface water	Low	Low	Low	Low	Low	None
Groundwater						
Water use (acre-feet)c	100	60	44	8	8	0
Water use (number of wells)	16	5	7	Truck water	Truck water	0
Biological resources and soils	Low	Low	Low	Low	Low	Very low
Cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources	None identified to archaeological, historical, or cultural resources; route near Moapa Indian Reservation and passes across 1.6-kilometer (1-mile) corner of the Las Vegas Paiute Indian Reservation	None identified to archaeological, historical, or cultural resources; route passes across 1.6-kilometer (1-mile) corner of the Las Vegas Paiute Indian Reservation	None identified to archaeological, historical, or cultural resources; IMT[d] and route near the Moapa Indian Reservation and passes across 1.6-kilometer (1-mile) corner of the Las Vegas Paiute Indian Reservation	Since shipments would use existing highways, none to archaeological or historical resources. Shipments from the northeast would pass through the Moapa Indian Reservation. All shipments would pass through the Las Vegas Paiute Indian Reservation
Noise	Low	Low	Low	Low	Low	Low
Utilities and resources						
Diesel (million liters)[e]	13	4.7	5.5	1.7	1.6	Very low
Steel (metric tons)[f]	49	14	21	2.3	2.3	0
Concrete (thousand metric tons)[g]	1.8	0.5	0.8	0.1	0.1	0
Aesthetics	Some potential near Caliente	Some potential near Caliente	Some potential near Caliente	Very low	Very low	None

Table 6-17. Comparison of impacts for Nevada heavy-haul truck implementing alternatives and for legal-weight truck shipments (page 2 of 3).

	Mostly rail with heavy-haul truck					
Impact	Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake	Mostly legal-weight truck
Socioeconomics						
New jobs (percent of workforce in affected counties)	860 (< 1% - 3.3%)	750 (< 1% - 4.9%)	590 - 1,980 (< 1% - 3.3%)	630 - 3,050 (< 1%)	490 - 1,880 (< 1%)	Very low
Peak real disposable personal income (million dollars)	27	22	19 - 65	21 - 97	16 - 62	Very low
Peak incremental Gross Regional Product (million dollars)	45	40	33 - 104	36 - 153	29 - 100	Very low
Waste management	Limited quantity	Limited quantity	Limited quantity	Limited quantity	Limited quantity	Very low
Environmental justice (disproportionately high and adverse impacts)	None	None	None	None	None	None
Incident-free health and safety						
Industrial hazards						
Total recordable incidents	310	270	260	150	150	NA[h]
Lost workday cases	160	140	140	80	80	NA
Fatalities	0.72	0.68	0.63	0.37	0.37	NA
Collective dose (person-rem [LCFs])						
Workers	1,600 [0.65]	1,200 [0.50]	1,400 [0.56]	1,200 [0.48]	1,100 [0.46]	1,900 [0.75]
Public	76 [0.038]	61 [0.030]	220 [0.11]	300 [0.15]	160 [0.08]	340 [0.17]
Fatalities from vehicle emissions	0.47	0.32	0.46	0.42	0.29	0.086
Accident impacts, nonradiological traffic						
Construction and operations workforce	3.5	2.4	3.0	1.7	1.7	NA
SNF[i] and HLW[j] shipping	0.6	0.33	0.43	0.25	0.23	0.49
Accident impacts, radiological						
Radiological accident risk						
Person-rem	0.01	0.002	0.056	0.12	0.056	0.053
Latent cancer fatalities	0.0000051	0.000001	0.000028	0.00006	0.000028	0.000026

Table 6-17. Comparison of impacts for Nevada heavy-haul truck implementing alternatives and for legal-weight truck shipments (page 3 of 3).

Impact	Mostly rail with heavy-haul truck					Mostly legal-weight truck
	Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake	
Maximum reasonably foreseeable accident						
Maximally exposed individual (rem)	29	29	29	29	29	3
Individual latent cancer fatality probability	0.014	0.014	0.014	0.014	0.014	0.0015
Collective dose (person-rem)	9,900	9,900	9,900	9,900	9,900	1,100
Latent cancer fatalities	4.9	4.9	4.9	4.9	4.9	0.55

a. To convert square kilometers to acres, multiply by 247.1.
b. Conformity determination could be required (see Chapter 6, Sections 6.3.3.1 and 6.3.3.2.3).
c. To convert acre-feet to gallons, multiply by 325,850.1.
d. IMT = intermodal transfer.
e. To convert liters to gallons, multiply by 0.26418.
f. To convert metric tons to tons, multiply by 1.1023.
g. To convert cubic feet to cubic meters, multiply by 0.028317.
h. NA = not applicable.
i. SNF = spent nuclear fuel.
j. HLW = high-level radioactive waste.

traffic facilities includes those that could occur when workers associated with highway or railroad construction commute to and from their work site. The estimates also include traffic fatalities that could result from highway accidents in delivering construction materials used to construct a branch rail line or upgrade highways and construct an intermodal transfer station. Construction and operations activities to transport spent nuclear fuel and high-level radioactive waste in Nevada could result in less than 1 to 5 traffic fatalities (0.5 or a 50 percent chance of 1 fatality to about 4.6). The fewest number of traffic fatalities would occur under the mostly legal-weight truck scenario, principally because the scenario would not require workers associated with construction and operations for Nevada rail implementing alternatives.

Because the trucks would use existing highways and be less than 1 percent of other commercial truck traffic on these highways, measurable impacts would not occur in environmental resource areas other than health and safety in Nevada for mostly legal-weight truck transportation. In contrast, the mostly rail scenario, or any other mix of rail and truck transportation that included a large amount of rail transportation, would require DOE to construct and operate a branch rail line in one of the five candidate rail corridors or construct and operate an intermodal transfer station and work with the State to upgrade highways to use one of the candidate routes for heavy-haul trucks. As a consequence, for the DOE-preferred mostly rail scenario, there would be impacts in Nevada to land use, air quality, hydrological resources, biological resources and soils, cultural resources, socioeconomics, aesthetics, noise and vibration, and waste management. Because it would require acquisition of a large area of land in the State, disturbance of land areas not previously disturbed, and the greatest amount of construction activity, construction of a branch rail line would have the potential to cause greater impacts in all resource areas except health and safety than would construction of an intermodal transfer station and highway upgrades. However, all five of the candidate rail corridors pass through sparsely populated or uninhabited areas of Nevada. Therefore, trains on a branch rail line after construction would have less day-to-day impact on daily life in communities than would heavy-haul trucks, which would share highways with other vehicles. Operational impacts (encompassing those impacts that would occur after construction of a branch rail line or highway upgrade for heavy-haul trucks) would be small in all resource areas for all ten of the rail and heavy-haul truck implementing alternatives.

In general, the longest rail corridor (Caliente) would have the largest potential for impacts, but there are exceptions. For example, construction of a branch rail line in the Valley Modified Corridor, which is the shortest of the five, could affect the Clean Air Act attainment objectives of Clark County for PM_{10} and carbon monoxide, for which the Las Vegas Valley air basin is currently in nonattainment. In addition, both the Jean and Valley Modified Corridors pass through desert tortoise habitat over their entire length and over a distance greater than the three longer corridors. The Wilson Pass Option of the Jean Corridor would require construction of a branch rail line in areas classified by the Bureau of Land Management as Class II for visual resource management. Construction and use of a branch rail line in these areas could be in conflict with Bureau Visual Resource Management guidelines. All five corridors and the Caliente/Chalk Mountain heavy-haul route have potential land-use conflicts at some points along their lengths. The ability of DOE to avoid or mitigate these conflicts varies among the implementing alternatives.

Construction or upgrading of the longest heavy-haul route (Caliente) would lead to the greatest potential for impacts, with some exceptions. For example, although most impacts of using an Apex/Dry Lake heavy-haul truck implementing alternative would be less than those of using a Caliente heavy-haul truck implementing alternative, the potential for impacts to air quality in the Las Vegas Valley air basin and impacts on traffic flow in the Las Vegas metropolitan area are greater for the Apex/Dry Lake route than for the Caliente route. In addition, socioeconomic impacts in Lincoln County, although small, would be greatest for construction and use of a Caliente/Chalk Mountain heavy-haul route. Furthermore, while health and safety impacts in small communities in Nevada, while small, would be greatest for a Caliente heavy-haul route, the shortest route would use the Las Vegas Beltway, which would pass through a highly populated commercial and residential area of North Las Vegas.

Each rail corridor and heavy-haul route could pass near or through areas having high percentages of minority or low-income populations. However, DOE has determined that there would be no environmental justice concerns for any of the proposed routes for heavy-haul trucks or corridors for a potential branch rail line because no potential impact to these populations would be both high and adverse.

LAND USE AND OWNERSHIP

DOE determined that information useful for an evaluation of land-use and ownership impacts should identify the current ownership of the land that its activities could disturb, and the present and anticipated future uses of the land. The region of influence for land-use and ownership impacts was defined as land areas that would be disturbed or whose ownership or use would change as a result of the construction and use of a branch rail line, intermodal transfer station, midroute stopover for heavy-haul trucks, and an alternative truck route near Beatty, Nevada.

AIR QUALITY

The evaluation of impacts to air quality considered potential emissions of criteria pollutants [nitrogen dioxide, sulfur dioxide, carbon monoxide, particulates with aerodynamic diameters of less than 10 micrometers (PM_{10})], lead, and ozone, the percentage of applicable standards and limits, and the potential for releases of these pollutants in the Las Vegas Valley. The region of influence for the air quality analysis included (1) the Las Vegas Valley for implementing alternatives that could contribute to the levels of carbon monoxide and PM_{10}, which are already in nonattainment of Clean Air Act standards (DIRS 101826-FHWA 1996, pp. 3-53 and 3-54), during the construction and operation of a branch rail line or highway for heavy-haul trucks, and (2) the atmosphere in the vicinity of the sources of criteria pollutants that transportation-related construction and operation activities would emit. The evaluation included a conformity review for emissions to the Las Vegas Valley air basin that would result from the Proposed Action.

HYDROLOGY

The analysis evaluated surface-water and groundwater impacts separately. The attributes used to assess surface-water impacts were the potential for introduction and movement of contaminants, potential for changes to runoff and infiltration rates, alterations in natural drainage, and potential for flooding or dredging and filling actions to aggravate or worsen any of these conditions. The region of influence for surface-water impacts included areas near construction activities, areas that would be affected by permanent changes in flow, and areas downstream of construction.

The analysis addressed the potential for a change in infiltration rates that could affect groundwater, the potential for introduction of contaminants, the availability for use for construction, the potential for changing flow patterns and, if available, the potential that such use would affect other users. The region of influence for this analysis included groundwater reservoirs.

BIOLOGICAL RESOURCES AND SOILS

The evaluation of impacts to biological resources considered the potential for conflicts with areas of critical environmental concern; special status species (plants and animals), including their habitats; and jurisdictional waters of the United States, including wetlands and riparian areas. The evaluation also considered the potential for impacts to migratory patterns and populations of big game animals. The region of influence for this analysis included the following:

- Habitat, including jurisdictional waters of the United States, including wetlands and riparian areas

- Migratory ranges of big game animals that could be affected by the presence of a branch rail line

DOE identified known biological resources within 5 kilometers (3 miles) of each rail corridor or variation. Resources were categorized based on proximity to the railroad—that is, inside the 400-meter-(0.25-mile)-wide corridor or outside the corridor but within 5 kilometers of the railroad. A railroad would be unlikely to influence some resources outside the corridor, such as populations of sensitive plant species or springs. It could influence other resources, especially those involving large game animals, horses, or burros, because they could traverse the distance to the railroad easily.

DOE identified soils classified as Easily Erodible, Prime Farmland, Shrink-Swell, Unstable Fill, or Blowing Soil along each route. No Prime Farmland was identified for any route. Although these soil characteristics would principally influence construction, they could influence the amount of land disturbed inside and outside the corridor and the local environment during construction, such as temporary increases in sediment loads in nearby waterways or springs, or entrainment of blowing soil.

The analysis assessed soil impacts to determine the potential to increase erosion rates by water or wind. The region of influence for the analysis of soil impacts included areas where construction would take place and downwind or downgradient areas that would be affected by eroded soil.

CULTURAL RESOURCES

The evaluation of impacts on cultural resources considered the potential for disrupting, or modifying the character of, archaeological or historic sites, artifacts, and other cultural resources, such as traditional cultural properties and cultural landscapes.

The specific region of influence for the *direct impact* analysis included the lands in the 400-meter (0.25-mile)-wide rail corridors, lands within existing highway rights-of-way that would be upgraded for heavy-haul truck use, and sites where an intermodal transfer station could be constructed and operated. The analysis assessed the potential for impacts to areas adjacent to a proposed rail corridor, such as landscapes traditional to American Indians or other historic cultural landscapes.

OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

The analysis of impacts to occupational and public health and safety from transportation-related activities in Nevada used the same methods, assumptions, attributes, and regions of influence used for the analysis of impacts of national transportation of spent nuclear fuel and high-level radioactive waste. However, it used the rail and highway accident rates reported for the State of Nevada (DIRS 103455-Saricks and Tompkins 1999, Table 4). The analysis also considered the daily average nonresident population in the Las Vegas metropolitan area for routes that pass through the Las Vegas metropolitan area.

In addition, the analysis included potential impacts from industrial hazards to Nevada workers from constructing and operating a branch rail line, upgrading highways for use by heavy-haul trucks, and constructing and operating an intermodal transfer station. The region of influence for the analysis included branch rail line and highway construction work sites and highways that workers and other construction-related vehicle traffic would use. The analysis considered potential radiological impacts from intermodal transfer station operations.

In addition, the analysis estimated doses to potential maximally exposed individuals in Nevada communities through which truck or rail shipments could travel. Appendix J, Section J.1.3.2.2 discusses the basis for these estimates. The health and safety portions of Sections 6.3.2.1 and 6.3.3.1 describe the potential impacts to maximally exposed individuals in Nevada.

SOCIOECONOMICS

The analysis of transportation-related socioeconomic impacts considered changes in annual levels of employment, population, housing, and schools, in addition to the economic measures of real disposable income, Gross Regional Product, and state and local government expenditures based on analyses DOE conducted using the Regional Economic Models, Inc. model (DIRS 148193-REMI 1999, all). The region of influence for the analysis included Clark, Lincoln, and Nye Counties. The other Nevada counties were included collectively in the Rest of Nevada analysis. The analysis considered impacts that would occur during construction and operation of the various transportation implementing alternatives.

The analysis expressed socioeconomic impacts as a percentage change, which it calculated by comparing the derived increase or decrease in a given socioeconomic parameter to the estimated baseline value for:

- Each county in the region of influence (Clark, Nye, and Lincoln), the Rest of Nevada, and the State of Nevada.
- The year.
- Economic measures (employment, population, real disposable income, Gross Regional Product, and State and local government spending).

Chapter 3, Section 3.1.7 lists the baseline values of each economic measure.

DOE has described the socioeconomic measures on a peak year basis for constructing a branch rail line, upgrading of highways, or constructing an intermodal transfer station and on an average basis for transportation operations. The Department used peak values and their impacts for construction because impacts would tend to be concentrated in 1 or 2 years. DOE used average values for the period of transportation operations as a more meaningful presentation of the data. Impacts, as a percentage of the baselines, would tend to be relatively stable over the 24 years of transportation operations for the Proposed Action.

In light of public comments received on the Draft EIS concerning perception-based and stigma-related impacts, DOE examined relevant studies and literature on perceived risk and stigmatization of communities to determine whether the state of the science in predicting future behavior based on perceptions had advanced sufficiently since scoping to allow DOE to quantify the impact of public risk perception on economic development or property values in potentially affected communities. Of particular interest were those scientific and social studies carried out in the past few years that directly relate to either Yucca Mountain or to DOE actions such as the transportation of foreign research reactor spent nuclear fuel. DOE also reevaluated the conclusions of previous literature reviews such as those conducted by the Nuclear Waste Technical Review Board and the State of Nevada, among others. DOE has concluded that:

- While in some instances risk perceptions could result in adverse impacts on portions of a local economy, there are no reliable methods whereby such impacts could be predicted with any degree of certainty
- Much of the uncertainty is irreducible, and
- Based on a qualitative analysis, adverse impacts from perceptions of risk would be unlikely or relatively small.

While stigmatization of southern Nevada can be envisioned under some scenarios, it is not inevitable or numerically predictable. Any such stigmatization would likely be an aftereffect of unpredictable future events, such as serious accidents, which may not occur. As a consequence, DOE did not attempt to quantify any potential for impacts from risk perceptions or stigma in this Final EIS. Chapter 2, Section 2.5.4 contains further detail.

NOISE AND VIBRATION

Nevada does not have a noise code, so the analysis used daytime and nighttime noise standards adopted by Washington State (Washington Administrative Code 173-58-040 to 173-60-040) for residential and commercial areas as benchmarks and for establishing the region of influence for potential impacts. DOE used these benchmarks [60 dBA for residential use (nighttime reduction to 50 dBA), 65 dBA for light commercial, and 70 dBA for industrial zones] to evaluate the impacts of noise from construction and operational activities for receptors in the region of influence near transportation facilities and corridors. Noise levels in areas and communities outside the region of influence were not addressed. To analyze the potential for community noise impacts, DOE established the region of influence as 1,000 meters (about 0.63 mile) based on the residential nighttime benchmark. This is the approximate distance from a railroad or highway at which the sound levels from passing trains or traffic would fall below 50 dBA. The distances for noise levels from a railroad to fall below 50 dBA (nighttime residential noise standard) and 60 dBA (daytime residential guideline) are 1,000 meters and 450 meters (about 0.25 mile), respectively.

DOE also defined a region of influence for locations where there would be a potential for impacts to solitude. These locations would include sites of special interest to Native Americans, where DOE assumes a sound level of 20 dBA would be necessary for solitude. This distance from passing trains or traffic would be about 6,000 meters (3.7 miles). To provide some perspective on the potential severity of noise impacts, the analysis estimated the population within 2 kilometers (about 1.3 miles) of each proposed rail corridor and heavy-haul truck route.

In addition to noise standards, the analysis assessed the frequency at which transportation noise from construction or operation of a transportation route could lead to complaints. It considered the proximity of transportation routes to centers of population and the frequency of shipments.

The analysis also considered potential effects of ground vibration from trains and heavy-haul trucks. In general, the operation of trains and trucks does not create vibration levels of an intensity that can damage most buildings unless they are very close to the rail line or highway (DIRS 155547-HMMH 1995, p. 8-3). Because trucks run on inflated tires, ground vibration is greatly reduced and the only situation that can produce potentially damaging ground vibration occurs when the vehicle strikes a bump or hole in the road. The intensity of the vibration depends on the size of the bump, speed and weight of the vehicle, and geology. Ground vibration can be disturbing to people, particularly at night, and it can adversely affect vibration-sensitive activities such as semiconductor manufacturing, operation of electron microscopes, and other activities. The U.S. Department of Transportation has proposed critical distances for the evaluation of ground vibration (DIRS 155547-HMMH 1995, pp. 9-4 and 8-3). These are expressed in feet and are based on the *decibel* scale for vibration (VdB) of root-mean-square (in relation to a microinch per second base). (A microinch is one-millionth of an inch or 0.0000025 centimeter; this measurement is used in applications that require extremely tight tolerances.) The endpoint for sensitive buildings is 65 VdB and the corresponding critical distance is 600 feet (about 180 meters). For human annoyance, the critical distance is based on 72 VdB and corresponds to 200 feet (about 61 meters). The estimated critical distance for structural damage due to the operation of unit coal trains is 100 meters (about 330 feet) based on a peak particle velocity measurement of 0.1 inch per second. Trains traveling to Yucca Mountain would include two locomotives and probably no more than 10 cars. The U.S. Department of Transportation (DIRS 155547-HMMH 1995, all) has proposed a structure protection criterion of

0.12-inch-per-second peak particle velocity. A corresponding region of influence is 100 meters (about 330 feet). High levels of ground vibration can be managed in sensitive areas by reducing the speed of the trains, a factor that usually occurs for safety purposes. Most of the candidate rail corridors to Yucca Mountain are in open or isolated areas with few structures; as a consequence, the chance of building damage from the operation of trains would be very small.

The analysis of impacts on biological resources considered the effects of environmental noise from trains and trucks on animals. There are no standards or regulatory measures for such impacts.

AESTHETICS

The analysis of potential impacts on aesthetic resources considered Bureau of Land Management ratings for land areas (DIRS 101505-BLM 1986, all). The regions of influence used in the analysis included the landscapes along the potential rail corridors and highway routes and near possible locations of intermodal transfer stations with aesthetic quality that construction and operations could affect.

The analysis of impacts was based on visual sensitivity ratings of viewsheds in Nevada and the Bureau of Land Management Visual Resource Management System objectives. It established ratings for scenery based on the number and types of users, public interest in the area, and adjacent land uses. The ratings are based on the scenic quality classes in the Bureau of Land Management Visual Resource Management System (DIRS 101505-BLM 1986, all).

UTILITIES, ENERGY, AND MATERIALS

The attributes used to assess impacts to utilities, energy, and materials included the requirements for electric power, fossil fuel for construction, and key consumable construction materials. The analysis compared needs to available capacity. The region of influence included the local, regional, and national supply infrastructure that would have to satisfy the needs.

WASTE MANAGEMENT

Evaluations of impacts of waste management considered the nonhazardous industrial, sanitary, hazardous, and low-level radioactive wastes that the Proposed Action would generate. The region of influence included construction areas and camps and facilities that would support transportation operations such as locomotive and railcar maintenance facilities.

ENVIRONMENTAL JUSTICE

DOE performs environmental justice analyses to identify whether any high and adverse impacts would fall disproportionately on minority and low-income populations. There would be a potential for environmental justice concerns if the following occurred:

- *Disproportionately high and adverse human health effects to minority or low-income populations:* Adverse health effects would be risks and rates of exposure that could result in latent cancer fatalities and other fatal or nonfatal adverse impacts to human health. Disproportionately high and adverse human health effects occur when the risk or rate for a minority or low-income population from exposure to a potentially large environmental hazard appreciably exceeds or is likely to appreciably exceed the risk to the general population and, where available, to another appropriate comparison group (DIRS 103162-CEQ 1997, all).

- *Disproportionately high and adverse environmental impacts to minority or low-income populations:* An adverse environmental impact is one that is unacceptable or above generally

accepted norms. A disproportionately high impact is an impact (or the risk of an impact) to a low-income or minority community that significantly exceeds the corresponding impact to the larger community (DIRS 103162-CEQ 1997, all).

The approach to environmental justice analysis first brings together the results of analyses from different technical disciplines that focus on consequences to certain resources, such as air, land use, socioeconomics, air quality, noise, and cultural resources, that could affect human health or the environment. The environmental justice approach considers assessments from these disciplines that identify potential impacts on the general population. Second, based on available information, the approach assesses if there are unique exposure pathways, sensitivities, or cultural practices that would result in high and adverse impacts on minority and low-income populations. If potential impacts identified under either assessment would be high and adverse, the approach then compares the impacts on minority and low-income populations to those on the general population to determine if any high and adverse impacts would fall disproportionately on minority and low-income populations. In other words, if high and adverse impacts on a minority or low-income population would not appreciably exceed the same type of impacts on the general population, disproportionately high and adverse impacts would be unlikely. In making these determinations, DOE considers geographic areas that contain high percentages of minority or low-income populations as reported by the Bureau of the Census.

The EIS definition of a minority population is in accordance with the basic racial and ethnic categories reported by the Bureau of the Census. A minority population is one in which the percent of the total population comprising a racial or ethnic minority is meaningfully greater than the percent of such groups in the total population; for this EIS, a minority population is one in which the percent of the total population comprising of a racial or ethnic minority is 10 percentage points or more higher than the percent of such groups in the total population (DIRS 103162-CEQ 1997, all). Nevada had a minority population of 34.8 percent in 2000 (see Chapter 3, Section 3.1.13 for a discussion of population information). For this EIS, therefore, one focus of the environmental justice analysis is the potential for transportation-related activities of the Proposed Action to have disproportionately high and adverse impacts on the populations in census tracts in the region of influence (principally in Clark, Nye, and Lincoln Counties) with a minority population of 44.8 percent or higher.

Nevada had a low-income population of 10 percent in 1990. Using the approach described in the preceding paragraph for minority populations, a low-income population is one in which 20 percent or more of the persons in a census block group live in poverty, as reported by the Bureau of the Census in accordance with Office of Management and Budget requirements (DIRS 152051-OMB 1999, all; DIRS 103127-Bureau of the Census 1999, pp. 114 and 116). Therefore, the second focus of the environmental justice analysis for this EIS is the potential for the Proposed Action to have disproportionately high and adverse impacts on the populations in census block groups with a low-income population of 20 percent or higher.

In response to comments, DOE has updated and refined available information to determine whether the Draft EIS overlooked any unique exposure pathways or unique resource uses that could create opportunities for disproportionately high and adverse impacts to minority and low-income populations, even though the impacts to the general population would not be high and adverse. The Department identified and analyzed several unique pathways and resources (for example, cultural and aesthetic resources, land use, air quality, and noise), but none revealed a potential for disproportionately high and adverse impacts (see Section 6.3 and Appendix J, Section J.3). DOE has updated and refined information germane to environmental justice analysis, including additional and more detailed mapping of minority populations (see Appendix J, Section J.3.1.2).

Section 6.3.4 describes the results of the analysis for the Nevada transportation scenarios.